

# Summary: USEPA 2013 Workshop on Nutrient Pollution Indicators in Streams - Proceedings

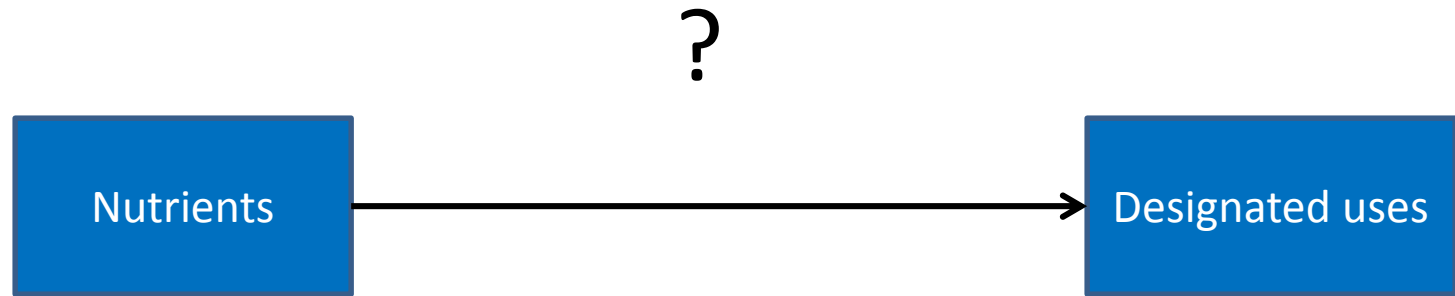
*Brannon Walsh, USEPA National Nutrient Criteria Program*



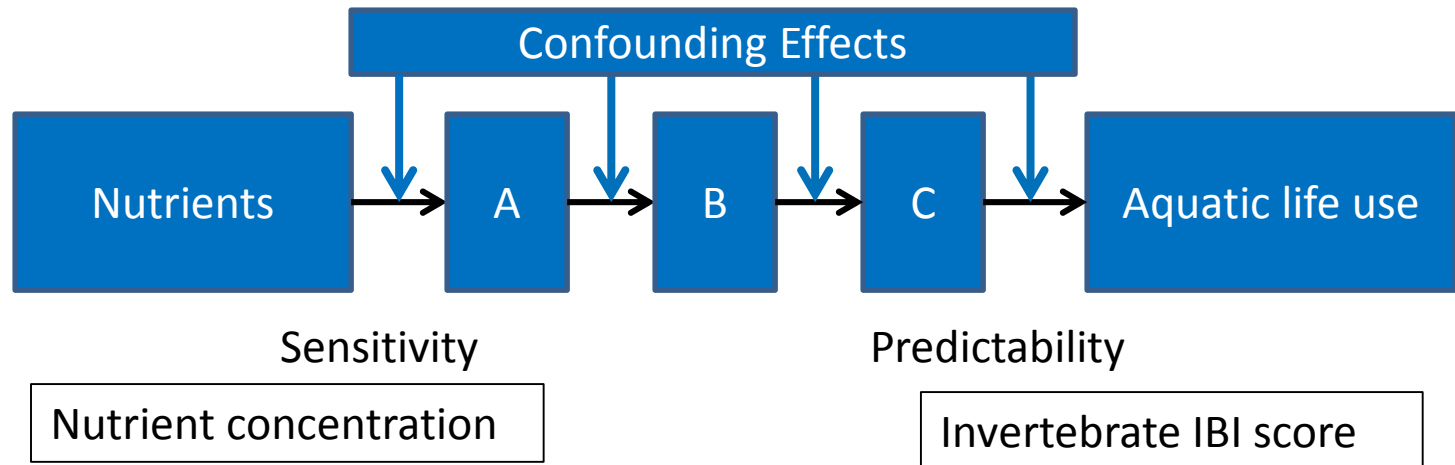
# Talk Outline

- I. Background
- II. Research questions
- III. Results
- IV. Next steps

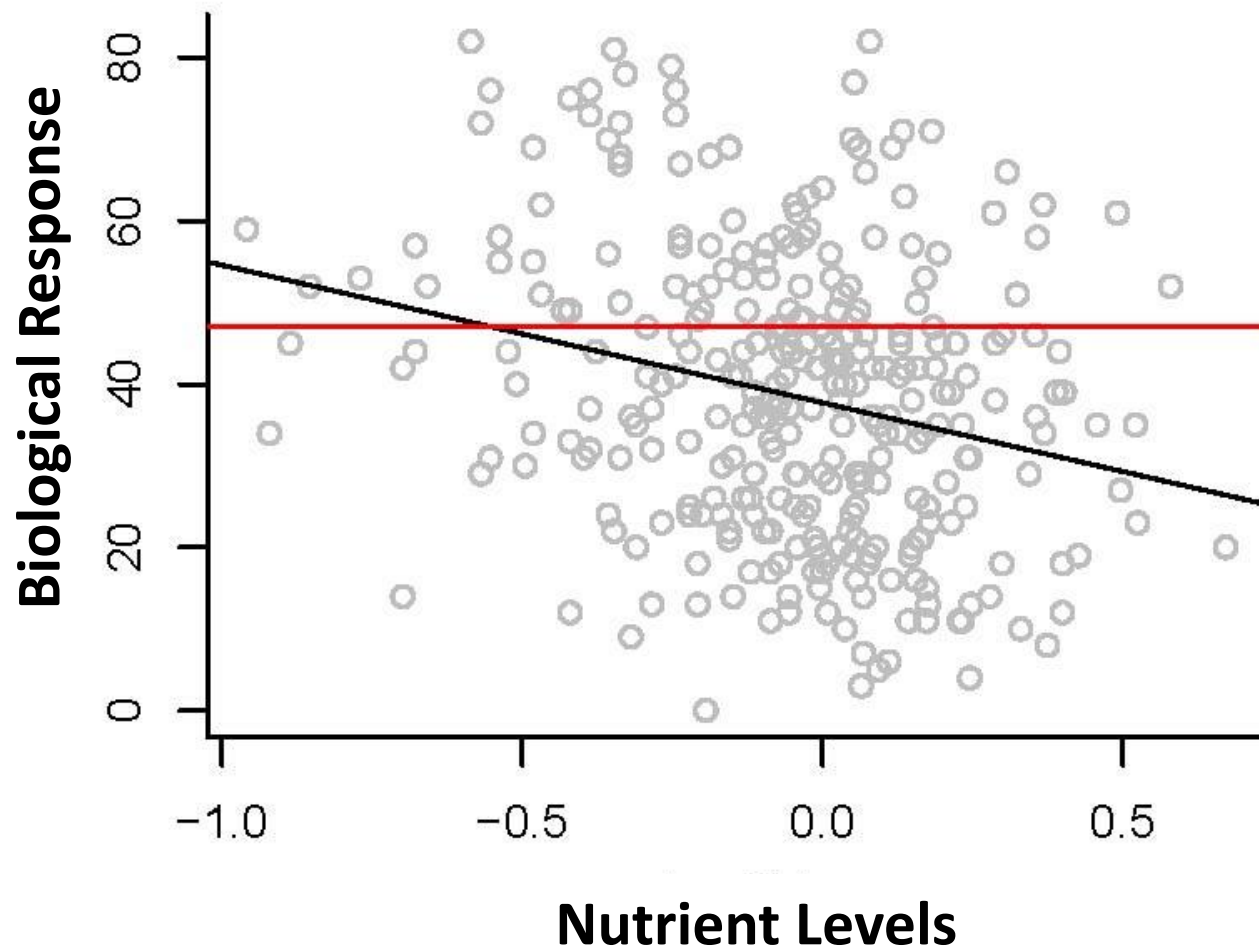
# I. Background



# I. Background



# I. Background



# I. Background

- Combined criteria
  - Combines multiple nutrient-related thresholds into a single assessment decision (e.g., total nitrogen/phosphorus, chlorophyll-a), which may increase confidence in assessment decisions.

## II. Research questions

- What suite of causal and response information is best suited for detecting adverse effects from nutrient pollution?
  - Sensitive to nutrient pollution exposure (high signal:noise)
    - Signal (informative response)
    - Noise (natural fluctuation)
  - Predictive of management objectives
    - If indicator exceeded, designated uses are likely to be unsupported
  - Easy and inexpensive to measure

## II. Research questions

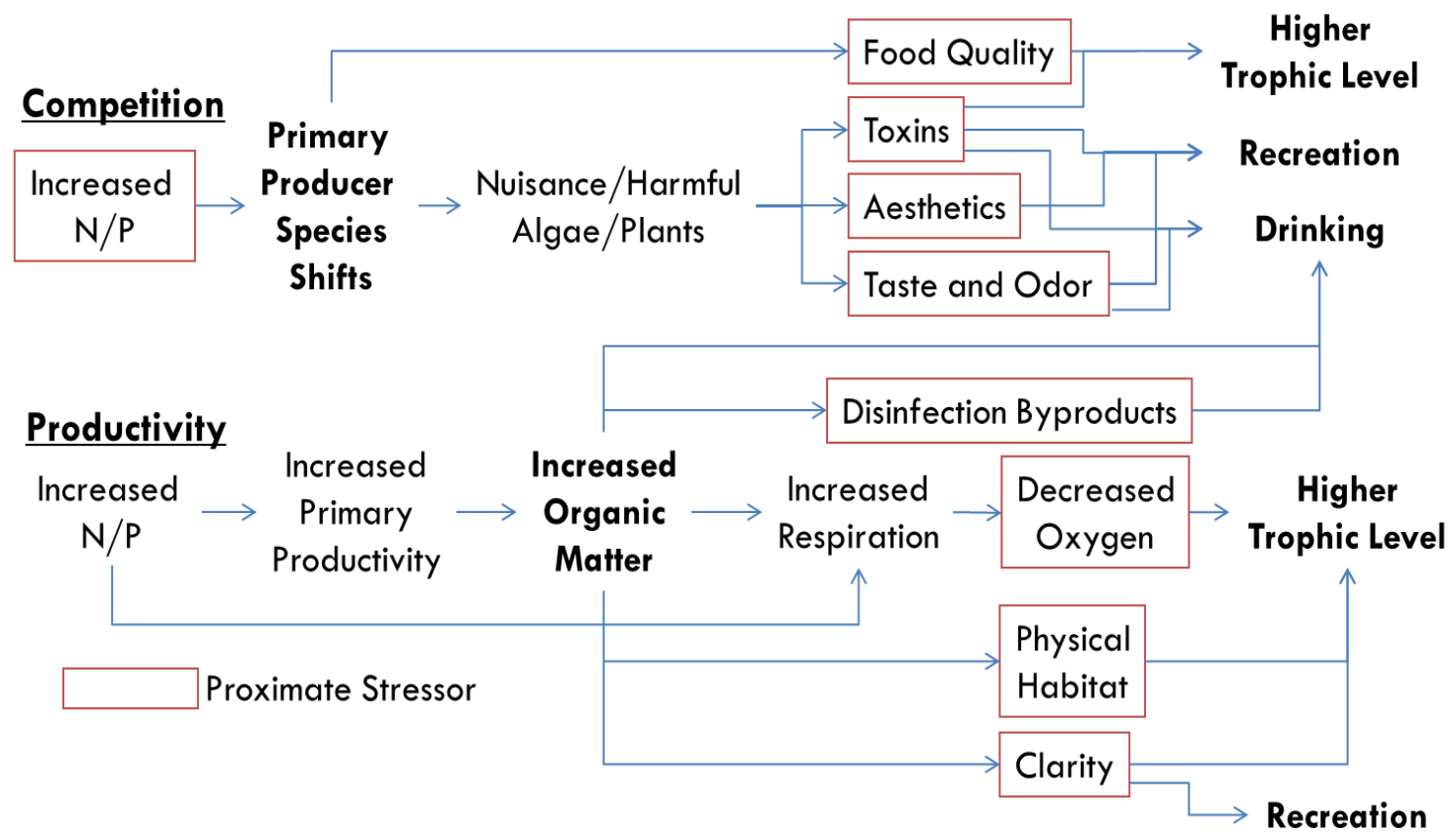
- How can this information be integrated and structured as a single criterion?
  - Protect the designated use.
    - Exceedance of criteria triggers action prior to actual impairment of the designated use.
  - Demonstrated improvement of “criteria accuracy”.
    - Criteria accuracy: streams that are impaired or likely to be impaired by excess nutrients fail the criteria.
  - Include numeric nutrient targets.
    - Facilitates permitting and TMDLs.



# **Expert Workshop: Nutrient Enrichment Indicators in Streams – April 16-18, 2013**

- Participants: 22 scientific experts from various state, federal, academic organizations
- Format: open discussion, breakouts, and writing sessions
- Products: annotated outlines for “ideal” indicators, example combined approaches

# III. Results



	Competition Pathway	Productivity Pathway
Level I – Nutrient Enrichment	Nutrient Concentrations	Nutrient Concentrations
	Nutrient Loads	Nutrient Loads
	Nutrient Acquiring Enzymes	Nutrient Acquiring Enzymes
Level II – Initial Responses	Richness/Diversity	Primary productivity
	Photo-pigment shifts	Primary production proteins
	Phospholipid profiles	Primary producer biomass
	Gene-based tools/indicators of species change	Heterotroph biomass/productivity
Level III – Proximate Stressors	User Perception Scores	Habitat scores/specific algal based habitat measures
	Toxin concentrations	Turbidity/Volatile Suspended Solids/Secchi/Transparency tube
	Concentration/expression of toxin genes/proteins	Dissolved organic carbon – disinfection active organic compounds
	Biomass/abundance of toxin producing taxa	Dissolved oxygen/metabolism
	Concentration of taste and odor chemicals	Decomposition/decay rates/heterotroph activity/ heterotroph proteins
	Concentration/expression of taste and odor genes/enzymes	
Level IV – Higher Trophic Level Response	Biotic index	Biotic index
	User data	User data
	Drinking water violations	Drinking water violations

Nutrients
Total nutrients (1, 2, 3, 4)
Soluble nutrients (1, 2, 4)
Inorganic nutrients (3 for local scale)
Sediment/pore water (3)
Primary Producer Biomass Indicators
Visual percent cover (1, 2 for mid-order streams, 4)
Phytoplankton and/or periphyton; chl-a and/or AFDM (1, 2, 3, 4)
Sestonic chl-a for large rivers (2, 3)
Macrophyte cover (3)
Biovolume (4)
Primary Producer Assemblage Indicators
Algal species composition (1, 2, 3, 4, 5)
Periphyton chemistry (2 for mid-order streams)
Cyanotoxins (2 novel)
Geosmin (2 novel)
Visual assemblages (4)
Algal/Heterotrophic Physiology Indicators
Nitrogen- and phosphorus-acquiring enzymes (2, 4, 5 for large streams)
Genomics (4 novel)
Flourometric measures (4 novel)
Higher Trophic Level Indicators
Macroinvertebrates (2, 3, 4, 5)
Benthic and riffle-dwelling fishes (2 for mid-order streams)
Pearly mussels (2 novel)
Ecosystem Functional Measures
Diel DO and pH (1, 2, 3, 4, 5 for large streams)
BOD (2 for headwaters with high reaeration)
Denitrification/ammonium oxidation gene frequencies (2 for headwater streams, 3)
Leaf decomposition (3, 4)
Uptake length (3 novel)
Nutrient limitation studies (3)

# III. Results

- Top indicators for a combined approach
  - Nutrients: TN, TP
  - Primary producers: chl-a, percent visual coverage of algae and macrophytes, and algal assemblage
  - Ecosystem function: Continuously measured DO and pH
  - Higher trophic levels: macroinvertebrate metrics
    - Useful as supplementary indicators that provide a link to aquatic life use, understood by the public

# III. Results

- Common application of indicators
  - Any adverse response is an indication of non-attainment.
  - Proper classification of waterbodies is fundamental to reducing variability in nutrient responses.
  - Sufficient data is important for criteria development and assessment.

# III. Results

- Combined criterion examples
  - Simple matrix
  - Range approach

# Simple Matrix

Considers a water “impaired” if causal AND any response parameter are exceeded.

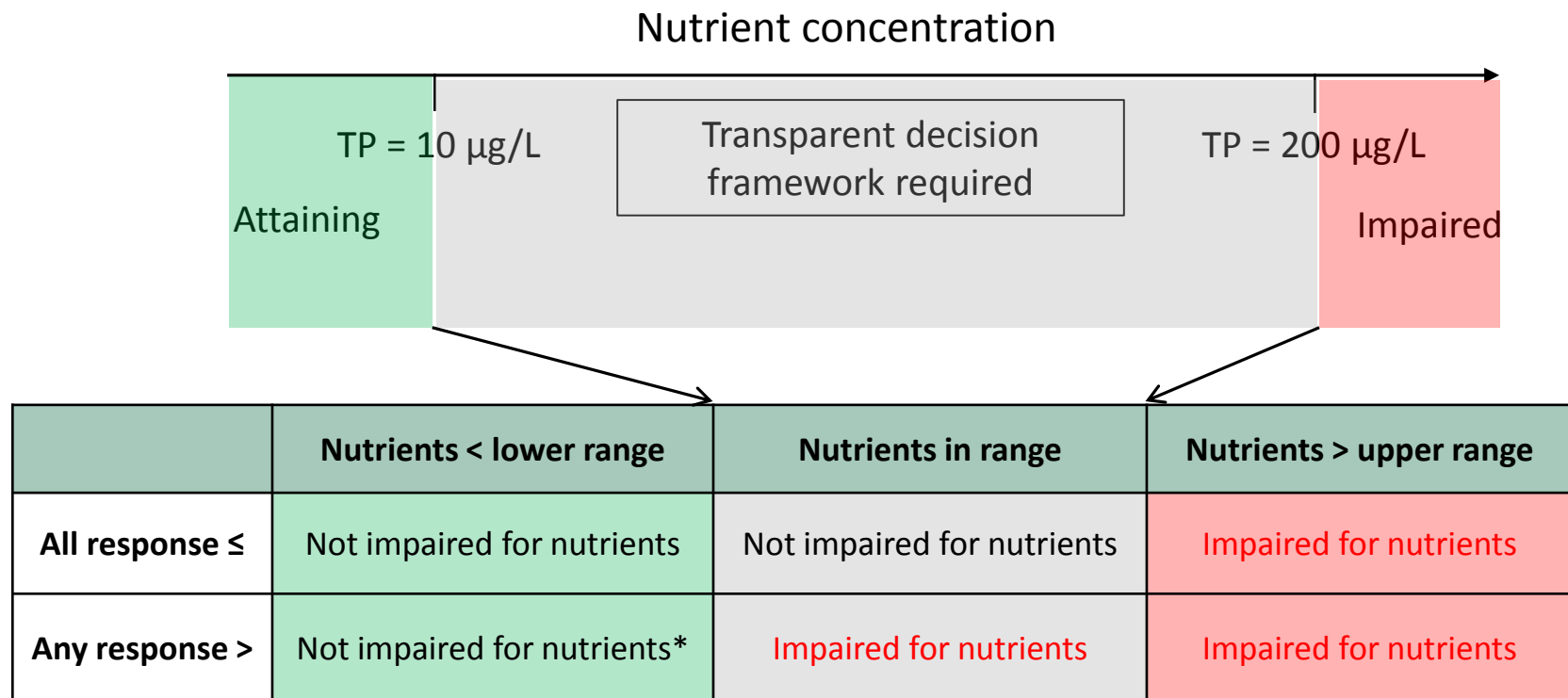
	Nutrients $\leq$	Nutrients $>$
All response $\leq$	Not impaired	Not impaired*
Any response $>$	Impaired (cause not determined)	Impaired

\*Site might be candidate for site-specific criteria.



# Range Approach

If causal parameters are within range, response parameters are required to assess attainment.



\*Site impaired for biological response condition, cause unknown.

## IV. Next steps

- Identified Research Needs
  - Working to improve nationally consistent diatom taxonomy
  - Developing best practices for diatom and soft bodied algae sampling and interpretation
  - Exploring novel methods of algal assessment using metagenomics
  - Developing a white paper on User Perception Surveys for benthic algae in streams
- Released Guiding Principles for combined approaches (Sept 2013)
  - Includes policy guidance

# Questions?

**Full proceedings and Guiding Principles can be downloaded here:**

- [www2.epa.gov/nutrient-policy-data/expert-workshop-nutrient-enrichment-indicators-streams](http://www2.epa.gov/nutrient-policy-data/expert-workshop-nutrient-enrichment-indicators-streams)
- <http://www2.epa.gov/sites/production/files/2013-09/documents/guiding-principles.pdf>